

REMARKS

Summary

Claims 1-9 are pending. Claim 1 has been rewritten. No new matter has been added as a result of this amendment. The amendments find support in the specification. No new matter has been introduced as a result of these amendments. The changes from the previously amended claim to the currently amended claim are shown in the "AMENDMENTS TO THE CLAIMS" section, with strikethroughs for deleted matter and underlines for added matter.

Rejection under 35 U.S.C. § 112, first paragraph

The Examiner has rejected claims 1, 2 and 7-9 under 35 U.S.C. § 112, first paragraph, because accordingly, the specification, while enabling for a MnX alloy, does not reasonably enable any alloy "containing at least one element selected from the group consisting of Pt, Pd, . . . Kr, and Mn."

Applicant has amended claim 1 such that it recites an antiferromagnetic layer and bias layer that comprises an alloy containing Mn and at least one element selected from a group consisting of Pt, Pd, Rh, Ru, Ir, Os, Au, Ag, Cr, Ni, Ne, Ar, Xe, and Kr, similar to that originally presented in the application as filed. Applicant respectfully submits that the above alloy composition as recited in the currently amended claim 1 meets the requirements of 35 U.S.C. § 112, first paragraph. Applicant therefore submits that claims 1, 2 and 7-9 overcome the 35 U.S.C. § 112, first paragraph rejection.

Rejection under 35 U.S.C. § 102(e)

The Examiner has rejected claims 1, 7, and 8 under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 6,074,767 ("Lin") for the reasons set forth in paragraph 10 of the May 6, 2002 Office Action. The Examiner has referred to Fig. 3 of Lin ("Figure 3, recesses are the regions where element 41 is deposited") in the May 6, 2002 Office Action and asserted that Lin discloses a free magnetic layer that anticipates claims 1, 7, and 8 of the instant application.

Claim 1 has been amended to recite: (a) a track width is defined at a level at which soft magnetic layers fill the recesses in the free magnetic layer; and (b) a height of the soft magnetic layers exceeds a depth of the recesses. Amended claim 1 recites a spin-valve magnetoresistive sensor that includes soft magnetic layers that are arranged on a free magnetic layer and that have spacing between them corresponding to a track width defined at a level at which the soft magnetic layers fill recesses in the free magnetic layer and in which a thickness of the soft magnetic layers exceeds a depth of the recesses.

As recited in claim 1, the soft magnetic layers fill, and in fact are thicker than, the recesses in the free magnetic layer and the track width is defined at the level at which the soft magnetic layers fill the recesses. Such an arrangement has certain advantages. First of all, because the intensity of longitudinal bias applied to the free magnetic layer is proportional to the thickness of ferromagnetic film \times saturation magnetization in areas on both sides of the track width/the thickness of ferromagnetic film \times saturation magnetization of the free magnetic layer, if no recesses were provided the intensity would be much stronger than necessary. Without these recesses, dead areas at both ends of a track and/or deterioration in the sensitivity of the sensor as a whole may occur.

In addition, the thickness of the soft magnetic layer is important. If the soft magnetic layer is too thick, the longitudinal bias is too susceptible to the external magnetic field, which causes the reproduced waveform to become unstable. However, if the soft magnetic layer is too thin, deterioration occurs to the exchange-coupled magnetic field between the bias layer and the soft magnetic layer as, for example, the soft magnetic layer cannot maintain satisfactory integrity of crystallinity. By providing the recesses as well as a soft magnetic layer whose thickness is larger than that of the recesses, the thickness of the free and soft magnetic layer combination does not increase proportionally as much as that of the soft magnetic layer. As a result, the longitudinal bias problem above is prevented while simultaneously avoiding deterioration of the exchange-coupled magnetic field between the bias layer and the soft magnetic layer. This results in improvement of the reproduction sensitivity, track width controllability, and stability of the reproduced waveform.

Lin does not anticipate or disclose an arrangement in which the thickness of the soft magnetic layer is larger than that of the recesses or in which the track width is defined at a level at which the soft magnetic layers fill recesses in the free magnetic layer. As shown in Fig. 3, to the extent that Lin discloses a free magnetic layer having recesses, he teaches the exact opposite: that the thickness of the soft magnetic layer is substantially smaller than that of the recesses, thereby allowing an antiferromagnetic film to be disposed inside the recesses as well. Nor does Lin disclose any particular reason for increasing the thickness of the soft magnetic layers or decreasing the thickness ratio above (Lin is primarily motivated to provide a magnetic head with strong thermal stability). Furthermore, the track width in Lin appears to be defined not at the soft magnetic layer level, as recited in claim 1, but as defined by the conductive layers.

For at least these reasons, Lin does not anticipate or disclose the arrangement of claim 1. Thus, claim 1 is patentable over Lin.

Rejection under 35 U.S.C. § 103(a)

The Examiner has made the following rejections of claims 1-9 under 35 U.S.C. § 103(a) based on Lin, U.S. Patent No. 6,201,673 ("Rottmayer"), U.S. Patent No. 6,007,643 ("Kishi"), and Applicant's disclosure.

Claims 3 and 4 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Lin for reasons set forth in paragraph 12 of the May 6, 2002 Office Action.

Claims 2 and 9 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Lin in view of U.S. Patent No. 6,201,673 ("Rottmayer") and Applicant's disclosure for reasons set forth in paragraph 13 of the May 6, 2002 Office Action.

Claims 5 and 6 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Lin in view of Rottmayer, Applicant's disclosure, and Kishi for the reasons set forth in paragraph 14 of the May 6, 2002 Office Action.

Claims 1-4 and 7-9 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Rottmayer in view of Applicant's disclosure for reasons set forth in paragraph 15 of the May 6, 2002 Office Action.

Claims 5 and 6 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Rottmayer in view of Applicant's disclosure and Kishi for reasons set forth in paragraph 16 of the May 6, 2002 Office Action.

To establish a *prima facie* case of obviousness, a reference or combined references must disclose every limitation of a claim. MPEP, 8th ed., Section 2143, lines 8-10, page 2100-122 (2001) citing *In re Vaeck*, 947 F.2d 488 (Fed Cir. 1991). Applicant respectfully submits that the current amendment to claim 1 overcomes the above rejections of claims 1-9 under 35 U.S.C. § 103(a). None of the various references cited by the Examiner, either individually or in combination, disclose every limitation of the currently amended claim 1 and previously amended claims 2-9, which all depend from claim 1. In addition, none of the various references cited by the Examiner, individually or in combination, teach or suggest the present invention. The teaching or suggestion to make the claimed combination and reasonable expectation of success must arise from the prior art, rather than from the Applicant's disclosure. MPEP, 8th ed., Section 2143, lines 11-15, page 2100-122 (2001). Thus, claims 1-9 cannot be rendered obvious by any of the references cited by the Examiner, either individually or in combination.

The Examiner states that claim 1 would have been obvious because Rottmayer teaches ion milling the capping layer until the free magnetic layer is exposed, and etching inherently removes some of the free magnetic layer and thus produces a recess before the soft magnetic layer deposition. Recesses, no matter how minute, may inevitably form during etching, but Rottmayer does not suggest that etching a capping layer until just after the free magnetic layer is exposed would form controllable recesses on the free magnetic layer that are similar to those recited in the claims.

The "recess" of Rottmayer substantially differs from the recess of the pending claims. The statement in Rottmayer that the Examiner relies on states that "[t]he etching preferably stops just after the top ferromagnetic layer 126, 126', or 126" is exposed." Looking at Figs. 3A, 4, and 5 of Rottmayer, which depict the top ferromagnetic layers 126, 126', and 126", the structures depicted in Figs. 3A, 4, and 5 of Rottmayer in no way suggest the structure of the present claims, much less the recesses of the present claims. The "recess" of Rottmayer that are alleged to be

inherently, albeit unintentionally, produced during the etching of the capping layer “just after the top ferromagnetic layer 126, 126', or 126” is exposed” is clearly not the same as the recess of the present claims that are intentionally formed as shown in, for example, Fig. 11 in the Applicant's disclosure.

When viewed under an electron microscope, for example, an etched surface that looks smooth with a naked eye could reveal indentations, or “recesses” caused by limitations in the attainable degree of control of an etching process. Thus, the formation of that type of “recess” of Rottmayer is feasible. Thus, Applicant submits that the “recess” upon which the rejections are based refer to those indentations on a surface that are formed, often unintentionally, during the etching of a surface using a method such as ion milling. But a reference's disclosing only that a capping layer is etched using a method, such as ion milling, until after another layer is exposed does not suggest that a controllable recess of the type claimed will be produced. To so assert would be a clear application of hindsight, which is impermissible. Rottmayer does not in any way suggest that the disclosed etching step, or any etching process, would produce the kind of recesses that is intentionally formed to overcome some particular technical limitations or problems involving spin-valve magnetoresistive sensors.

The Examiner states that Rottmayer's statement that “the etching preferably stops just after the top ferromagnetic layer is exposed” is equivalent to saying that “the top layer is exposed, additional etching takes place briefly, **then** the etching is stopped” (emphasis in the original). The Examiner notes that this is known in the art and cites Lin as teaching a “free layer that is at least partly etched away before depositing the subsequent soft magnetic layers.” But the level of skill in the art cannot be used as a basis for providing the suggestion to combine references. MPEP, 8th ed., Section 2143.01, lines 10-13, page 2100-123 (2001) *citing Al-Site Corp. v. VSI Int'l Inc.*, 174 F.d 1308 (Fed. Cir. 1999). In addition, none of the statements made by the Examiner directly above, or the statement in Rottmayer cited by the Examiner, makes any reference to recesses. The statements only refer to etching. And they merely imply, based on the Examiner's statements, that recesses or indentations are unavoidably formed during an etching process. Even assuming that the above interpretation by the Examiner is reasonable, it does not support or prove an assertion that a process

disclosed by Rottmayer teaches or suggests that the controllable recess of the present claims will be formed by Rottmayer's etching process, or by any etching process for that matter. The recess of the present claims is not simply an inevitable result of any etching process, but arises from a conscious and deliberate effort and design. This can be clearly seen by comparing Fig. 11 in Applicant's disclosure with Fig. 3 of Lin and Figs. 1A, 3A, 4, and 5 of Rottmayer.

Moreover, the rationale for forming the type of recess claimed explained in detail above is lacking in the cited references.

In addition to the requirement that a reference or combined references must disclose every limitation of a claim to show obviousness, the combined references must provide motivation to one of ordinary skill in the art to modify the teachings of the references to arrive at the claimed invention. MPEP, 8th ed., Section 2143.01, column 1, page 2100-123 (2001). For example, the cited references do not disclose, teach, or suggest that the claimed invention would have allowed one of ordinary skill in the art to obtain the advantages provided by the claimed invention.

The claimed invention provides several advantages, as discussed above. For example, the soft magnetic layer formed between the free magnetic layer and the bias layer allows the magnetization direction of the free magnetic layer to be arranged uniformly with certainty. Also, by forming a soft magnetic layer of the same material as that of the free magnetic layer, ferromagnetic coupling would be more likely occur at the interface between the soft magnetic layer and the free magnetic layer. As a result, a unidirectional and anisotropic exchange-coupled magnetic field produced at the interface between the bias layer and the soft magnetic layer can be transmitted to the free magnetic layer through the soft magnetic layer.

Another advantage is that the ferromagnetic coupling at the interface between the free magnetic layer and the soft magnetic layer is not as sensitive to contamination as the exchange coupling at the interface between a free magnetic layer and an antiferromagnetic layer. Thus, a sufficient level of a longitudinal magnetic field can be certainly imparted to the free magnetic layer even when the soft magnetic layer is formed after breaking vacuum and exposing the laminate to the atmosphere. Moreover,

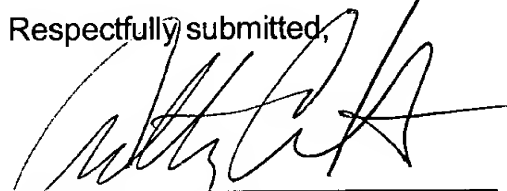
the surface of the laminate may be cleaned using techniques such as ion milling or reverse sputtering before forming the soft magnetic layer, without breaking vacuum.

For all of the above reasons, Applicant respectfully requests that the rejection of claims 1-9 under 35 U.S.C. § 103(a) be withdrawn.

Conclusion

In view of the amendments and arguments above, Applicant respectfully submits that all of the pending claims are in condition for allowance. If for any reason the Examiner is unable to allow the application in the next Office Action and believes that a telephone interview would be helpful to resolve any remaining issues, he is respectfully requested to contact the undersigned attorney or agent.

Respectfully submitted,

A handwritten signature in black ink, appearing to read 'Anthony P. Curtis', is written over a horizontal line.

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